The Effect of Customer Knowledge on Antimalarial Drug Quality

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Introduction

According to a recent meta-analysis, between 12 to 50 percent of anti-malarial drugs sold in sub-Saharan Africa are of substandard quality, or counterfeit (Nayyar et al., 2012). Low quality drugs may increase individual morbidity and mortality due to malaria, a leading cause of illness among adults and the second leading cause of death in children (WHO 2011). In addition, counterfeit drugs may threaten public health, because they increase parasitic drug-resistance (Okeke et al. 1999). Creating policies to improve market quality may therefore be key to lowering malarial burden in developing countries.

Despite the potential negative impact of these low-quality medicines, little is known about the causes or correlates of counterfeit drugs. Existing research focuses on descriptive analysis documenting that the problem exists in a range of countries. An exception is Björkman et al. (2013) who find that 19.4 percent of antimalarial drugs in Uganda are fake; they find that drug quality improves with increased competition and is positively correlated with customer knowledge of malaria transmission.

Background

In Uganda, where this study takes place, caregivers most commonly seek malarial treatment at drug shops due to problems of long lines, drug stock-outs, and poor service quality at public health facilities (Konde-Lule et al, 2011; Xu et al., 2005). This pattern of utilization is notable, because first-line malaria drugs are available for free at all public health facilities, yet relatively expensive in the private sector.

The reliance on the private sector for essential medicine delivery may have unintended consequences. Drug shopkeepers may have profit motives to sell fake drugs to unsuspecting customers at high prices. Customer misconceptions about malaria and appropriate treatment are common and may make customers susceptible to fraud (Deressa and Hailemariam, 2008). Low levels of market quality may also contribute to suboptimal usage of the first-line treatment, specifically artemether-lumefantrine (AL). Overall, one-third of caregivers do not seek treatment for symptomatic children, typically attributed to high prices and low levels of awareness of proper malaria treatment (DHS, 2011). However, standard economic theory predicts that when quality is unobservable, the equilibrium quantity is lower than the efficient level (Akerlof, 1970). Thus, understanding mechanisms of how to improve quality may also induce more customers to purchase effective anti-malarial drugs.

Primary Research Questions & Hypotheses

- Do shopkeepers adjust drug price or quality in response to whether they give customers information about a malaria diagnosis?
- Do shopkeepers adjust drug price or quality in response to whether customers lack

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product information about malaria treatment?

These questions are theoretically ambiguous. Profit-maximizing drug shopkeepers could increase prices and lower quality to extract rents from customers who lack information about their health or appropriate treatment, as in Tellis and Wernerfelt (1987). This is in contrast to a standard price discrimination model in which health knowledge is correlated with wealth, predicting that informed customers pay higher prices, and potentially receive higher quality.

Data and Methods

First, I conducted a census of all drug shops in randomly selected parishes in Western and Central Uganda. Second, two different mystery shoppers visited each drug shop found during the census. Each shopper was instructed to purchase a full adult dose of an anti-malarial drug with one of four randomly assigned scripts. All shoppers were trained, monitored, and followed a strict research protocol with respect to dress, behavior, and responses to common questions from the shopkeeper.

The scripts were implemented as follows. Shoppers first described to the shopkeeper the symptoms of malaria for a male family member who was sick. Shoppers either said that they thought that the patient had malaria, or instead asked for a diagnosis; then they either asked for the first-line treatment or for a treatment recommendation. The combination of believing that the patient has malaria, and knowing the first-line treatment can be thought of as the "control" script from which I measure average differences in price and quality in the three "comparison" scripts. Figure 1 graphically displays the research design and realized frequencies per cell.

Shoppers then bargained over the price, and purchased the cheapest first-line treatment available, AL. If AL was not available, then another drug was purchased. Shoppers then thanked the shopkeeper, left the shop, and immediately filled out a short survey on the transaction. All purchased drugs are then tested for quality, although results will not be available until November 2013.

Third, enumerators visited shops and conducted a survey on shopkeeper beliefs, background, and shop operations at each outlet. Finally, enumerators conducted exit interviews with customers in order to examine customer demographics and knowledge of malaria causes and treatment. A small-scale pilot for the project took place in November 2012; the full study took place from May to August 2013, and data entry is ongoing.

Empirical Strategy

I estimate the following equation:

(1) $$Y_{st} = \beta_0 + \beta_1 \text{Malaria\_Recommendation} + \beta_2 \text{Diagnosis\_AL} + \beta_3 \text{Diagnosis\_Recommendation} + \phi_s + \delta' X + \varepsilon_{st}$$

where *Malaria_Recommendation, Diagnosis_AL*, and *Diagnosis_Recommendation* are a set of dummy variables indicating the script in which the shopper displays knowledge that the patient has malaria or instead asks for a diagnosis; or, that the shopper asks specifically for AL or instead asks for a product recommendation. The omitted category is the script with the highest level of knowledge, Malaria_AL. Y_{st} is either price (paid or transaction, which differ due to bargaining) or drug quality for transaction t in shop s, ϕ_s is the shop fixed effect, and X is a matrix of shopper fixed effects and visit order controls.

Results

Results from the Pilot Study

I conducted a small-scale pilot with 28 drug outlets and 34 customers in November 2012. Laboratory analysis found that the 34 percent of purchases were counterfeit, meaning the sample failed a chemical assay. Mystery shoppers who asked for a treatment recommendation paid 19 percent more than those who asked the pharmacist for AL ($3.82 vs. $3.21). This difference is consistent with shopkeepers extracting information rents from uninformed consumers. Mystery shoppers who asked for a treatment recommendation also received slightly higher qualities of drugs on average.

A set of questions was asked of shopkeepers' and customers' knowledge of malaria. On a series of basic questions on malaria transmission shopkeepers scored an 83 percent on average, and customers scored 75 percent on average. These measures indicate substantial health literacy gaps from both customers and shopkeepers. Shopkeepers who were more knowledgeable on malaria transmission were more likely to have ever sold fake drugs. Measures of competition also appear unrelated to average drug quality.

Preliminary Results from Full Study

Table 1 presents summary statistics from 934 purchases at 474 different drug shops. Eighty-six percent of purchases were AL, and a full adult dosage was given in 91 percent of visits. Overall, 8.4 percent of the sample had markings indicating that they were stolen from public health facilities. Shoppers on average were offered a price of 8954 UGX ($3.49) and paid 7754 UGX ($3.03). Overall, 56 percent of shoppers successfully bargained. Although shoppers bought the cheapest brand of AL available at the store, in only 56 percent of visits did shoppers buy the same brand. These results indicate that shopkeepers adjust brand, and potentially quality, in response to scripts.

Table 2 contains results of average differences in price across each of the randomly assigned scripts. Columns 1 and 2 contain estimates for the dependent variable "the price offered"; 3 and 4 contain estimates for the dependent varible "the transaction price". The omitted category in all regressions is the "Malaria, Coartem" script where customers signaled to the shopkeeper that they had the highest level of knowledge. Although estimates are imprecise, the script in which the customer signals the least amount of information, "Diagnosis, Recommendation" is statistically significant at the 5 percent level (Columns 1 and 2). On average, shoppers reciting the "Diagnosis, Recommendation" script pay 714 UGX ($0.28) less; this is an 8 percent decrease from the overall average price. Columns 3 and 4, however, indicate that there is no difference in price paid between shoppers reciting different scripts. Estimates are small in magnitude with small standard errors. Even in the presence of bargaining and information constraints, the Law of One Price holds. There is no difference for the outcome of receiving the correct dosage between scripts (not shown). Other results are forthcoming.

Conclusion

This abstract outlines one of the first field experiments about counterfeit drugs. It tests whether individual customer knowledge affects drug quality and price at the shop level. I find that customers with the least amount of knowledge on average are offered higher prices; quality results are not yet available. These results have important implications for consumer welfare and interventions intended at reducing counterfeit drug rates in developing countries.

Figure 1: Scripts Recited at Visits

Malaria, AL	**Diagnosis, AL**
24.6%	25.40%
N=248	N=256
(omitted, full knowledge)	(med knowledge)
Malaria, Recommendation	**Diagnosis, Recommendation**
24.31%	25.69%
N=245	N=259
(med knowledge)	(low knowledge)

Notes: Above is the distribution of actual scripts recited to shopkeepers. Although marginal probabilities of each script were intended to be 0.25, in practice there was slippage due to closed shops and shopper error.

Table 1: Summary Statistics

Drug is AL	0.86
Correct Dosage	0.918
Government Drug	0.084
Price Offered (UGX)	8954
Price Paid (UGX)	7754
Bargained Successfully	0.56
Amount Reduced (UGX)	1146
Bought Same Brand at Visits	0.56

Notes: Results are summary statistics from the sample of 934 purchases form 474 drug outlets in the study. "AL" is an abbreviation for artmether-lumefantrine. Correct dosage is defined as a full adult dosage for the particular active ingredient.

Table 2: Effects of Shopper Scripts on Prices Offered To and Paid By Shoppers

	Price Offered		Price Paid	
VARIABLES	(1)	(2)	(3)	(4)
Malaria, Recommendation	-431.17	-507.74	-83.53	-22.44
	(341.18)	(347.23)	(186.11)	(188.04)
Diagnosis, Coartem	-245.71	-203.25	80.73	128.24
	(346.15)	(349.73)	(188.88)	(189.64)
Diagnosis, Recommendation	-727.11**	-714.01**	-91.54	-7.42
	(331.83)	(335.75)	(181.36)	(182.66)
Constant	9,252.53***	8,836.90***	7,744.99***	6,944.88***
	(266.41)	(765.65)	(136.78)	(414.35)
Controls (Visit Order, Shopper FE)		X		X
Shop Fixed Effect	X	X	X	X
Observations	932	927	930	924
R-squared	0.822	0.835	0.898	0.908

Notes: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

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